Massachusetts Institute of Technology
Instrumentation Laboratory
Cambridge, Massachusetts

LUMINARY Memo #102

TO: Distribution
FROM: George W. Cherry
DATE: August 6, 1969
SUBJECT: Some Results of the Apollo 12 Pinpoint Lunar Landing Data Priority Meeting

The meeting revolved around an eight point PDI state vector improvement program and several PCRs and Action Items were approved for MIT/IL.

State Vector Improvement Program

1. Use balanced couples in CSM (Apollo 11 did not, apparently).

2. Minimize RCS jet tests.

3. Eliminate LM station keeping.

4. No unscheduled venting; no unscheduled dumping.

5. Don't trim DOI burn residuals. Exit AVERAGE G as soon as possible!
Action Item to MIT/IL:
How do we get AVERAGE G off as soon as possible? Could the the program be modified to terminate AVERAGE G as soon as the PROCEED is entered to FL V16 N85? (Not possible for LUMINARY 1B)
Action assigned to:
Margaret Hamilton

6. Let ground know accurately what the DOI residuals are. The crew can write them down from the DSKY and later voice them down. But these are good to only 0.1 ft/sec and they are in LM body axes. Therefore, put the "VGTIG's" on the Coast/Align so that the ground can evaluate the burn after AOS.
PCR 284. VGTIG's on C/A Downlist. Approved.

7. Eliminate unbalanced couples in LM. This is not a necessary change. The LM fires single jets about the U-V axes only when minimum impulses are called for. The single jet unbalanced couples are employed to reduce the "sportiness" of the LM and save RCS propellants. A minimum impulse of translation is only about 0.7×10^{-6} ft/sec delta-V. Furthermore, the firing of +x and -x jets is randomized. With jet plume impingement on the thrust deflectors there is no such thing as balanced couples in the LM anyway.

8. Use latest tracking data to reduce LM state vector errors between AOS and PDI by updating the landing site vector. In order to get this update in without a P27 uplink in the crowded timeline a PCR was approved to permit the crew to modify all components of LAND (RLS in stable member coordinates.) This PCR is attached.

There was also a discussion of an improved CSM-docked LM alignment (Bob White's method).

Action Item: If the maneuvers which separate the CDU measurements in the two spacecrafts are separated by, say, a half hour, how is the drift test made by the first P52 affected. For timeline, Bob, talk to Charlie Parker or Bill Tindall.

Assigned to: Bob White.

We also discussed getting the LR velocity read on earlier for the downlink. The PCR, PCR 855, for doing this is attached.

APOLLO SPACECRAFT SOFTWARE CONFIGURATION CONTROL BOARD PROGRAM CHANGE REQUEST

NUMBER (Completed by FSB): 854

1.0 COMPLETED BY ORIGINATOR

1.1 ORIGINATOR	DATE	1.2 ORGANIZATION	APPROVAL	DATE
D. Eyles/G. Cherry	8/4/69	MIT/IL	G. W. Cherry	8/7/69

1.3 EFFECTIVITY: LUMINARY 1B

1.4 TITLE OF CHANGE: Provide a Flexible Method for Crew to Modify RLS.

1.5 REASON(S) FOR CHANGE:
For the pinpoint landing which Apollo 12 may attempt, it is desirable to give the crew a means of changing RLS through the DSKY.

1.6 DESCRIPTION OF CHANGE:
Provide a three-component noun (N69) which gives corrections to the landing site vector in stable member coordinates. (See following data amplification sheet.)

2.0 SOFTWARE CONTROL BOARD OR FLIGHT SOFTWARE BRANCH DECISION FOR VISIBILITY IMPACT ESTIMATE BY MIT

2.1 ☐ APPROVED ☐ DISAPPROVED

2.2 REMARKS:

2.3 SOFTWARE CONTROL BOARD OR FLIGHT SOFTWARE BRANCH SIGN OFF

DATE

3.0 MIT VISIBILITY IMPACT EVALUATION:

3.1 SCHEDULE IMPACT

3.2 IMPACT OF PROVIDING DETAILED EVALUATION

3.3 STORAGE IMPACT

3.4 REMARKS:
approved by C. Kraft
on 7/31/69

3.5 MIT COORDINATOR
G. W. C.

DATE

4.0 SOFTWARE CONTROL BOARD ACTION

4.1 ☐ IMPLEMENT AND PROVIDE DETAILED CHANGE EVAL. ☐ PROVIDE DETAILED CHANGE EVALUATION ☐ DISAPPROVED

4.2 REMARKS

4.3 SOFTWARE CONTROL BOARD SIGN OFF

DATE

5.0 MIT DETAILED PROGRAM CHANGE EVALUATION

5.1 MIT COORDINATOR

DATE

5.2 MIT EVALUATION

6.0 SOFTWARE CONTROL BOARD DECISION ON MIT DETAILED PROGRAM CHANGE EVALUATION

6.1 ☐ START OR CONTINUE IMPLEMENTATION ☐ DISAPPROVED OR STOP IMPLEMENTATION

6.2 REMARKS:

6.3 SOFTWARE CONTROL BOARD SIGN OFF

DATE

APOLLO SPACECRAFT SOFTWARE CONFIGURATION CONTROL BOARD
DATA AMPLIFICATION SHEET

PROGRAM CHANGE REQUEST NO.	PREPARED BY	DATE	ORGANIZATION
854	D. Eyles/G. Cherry	8/4/69	MIT/IL

CONTINUATION SECTION: *(Refer to Block Number and Title on Program Change Request form.)*

1.6 Description of Change, cont'd.

N69

R1 - ΔZ ft. (downrange in SM coordinates)
R2 - ΔY ft. (crossrange SM coordinates)
R3 - ΔX ft. (approximate altitude in SM coordinate)

Provide logic in the guidance equations to monitor these correction terms and when they are found non-zero to modify the landing site vector accordingly. (RLS, the site vector in selenographic coordinates would not be changed, only LAND, the site vector in platform coordinates actually used by guidance.) If the noun is loaded after the start of guidance (at throttle-up) the correction would be incorporated immediately; if the noun is loaded between the ignition algorithm and the start of guidance, the correction would be put in at the start of guidance; if the noun is loaded before the ignition algorithm, the change would be incorporated in the ignition algorithm and thus would influence light-up time. (Since RLS is not changed, reselection of P63 would wipe out any changes made using this technique.)

REMARKS:

APOLLO SPACECRAFT SOFTWARE CONFIGURATION CONTROL BOARD PROGRAM CHANGE REQUEST

NUMBER (Completed by FSB): 855

1.0 COMPLETED BY ORIGINATOR

1.1 ORIGINATOR	DATE	1.2 ORGANIZATION	APPROVAL	DATE
W. TINDALL/ G. CHERRY	8/4/69	MIT/IL	G. W. Cherry	8/4/69

1.3 EFFECTIVITY: LUMINARY 1B

1.4 TITLE OF CHANGE: Begin Reading LR Velocity as soon as Velocity Data Good Appears.

1.5 REASON(S) FOR CHANGE:

During the Apollo 11 landing, the LR locked on in both range and velocity as soon as the crew yawed the S/C windows-up. This occurred at about 39,000 ft. altitude and an inertial velocity of about 3000 ft/sec. Although the weighting functions for...

1.6 DESCRIPTION OF CHANGE:

Change the contents of the cell currently called 2KFT/SEC to 6000 ft/sec.

2.0 SOFTWARE CONTROL BOARD OR FLIGHT SOFTWARE BRANCH DECISION FOR VISIBILITY IMPACT ESTIMATE BY MIT

2.1 ☐ APPROVED ☐ DISAPPROVED

2.2 REMARKS:

2.3 SOFTWARE CONTROL BOARD OR FLIGHT SOFTWARE BRANCH SIGN OFF

DATE

3.0 MIT VISIBILITY IMPACT EVALUATION:

3.1 SCHEDULE IMPACT: 0

3.2 IMPACT OF PROVIDING DETAILED EVALUATION

3.3 STORAGE IMPACT: 0

3.4 REMARKS: Approved by T. Gibson on 8/11/69

3.5 MIT COORDINATOR: G. W. Cherry

DATE

4.0 SOFTWARE CONTROL BOARD ACTION

4.1 ☐ IMPLEMENT AND PROVIDE DETAILED CHANGE EVAL. ☐ PROVIDE DETAILED CHANGE EVALUATION ☐ DIS-APPROVED

4.2 REMARKS

4.3 SOFTWARE CONTROL BOARD SIGN OFF

DATE

5.0 MIT DETAILED PROGRAM CHANGE EVALUATION

5.1 MIT COORDINATOR

DATE

5.2 MIT EVALUATION

6.0 SOFTWARE CONTROL BOARD DECISION ON MIT DETAILED PROGRAM CHANGE EVALUATION

6.1 ☐ START OR CONTINUE IMPLEMENTATION ☐ DISAPPROVED OR STOP IMPLEMENTATION

6.2 REMARKS:

6.3 SOFTWARE CONTROL BOARD SIGN OFF

DATE

APOLLO SPACECRAFT SOFTWARE CONFIGURATION CONTROL BOARD
DATA AMPLIFICATION SHEET

PROGRAM CHANGE REQUEST NO.	PREPARED BY	DATE	ORGANIZATION
855	W. Tindall/G. Cherry	8/4/69	MIT/IL

CONTINUATION SECTION: *(Refer to Block Number and Title on Program Change Request form.)*

1.5 Reason(s) for Change, cont'd.

...LR velocity incorporation are very flexible - everything is in erasable - the criterion for reading velocity is not flexible. The LR velocities are not read until the LM's speed is less than a number in fixed storage. By changing this number, called 2KFT/SEC, to 6000 ft/sec, the radar velocities will be read as soon as the LR velocity data good discrete is received. The ground therefore will see the measured LR velocities as soon as they are available and the LGC erasable values of the weighting functions could be modified to incorporate same components of velocity sooner. If these erasables are not modified from Apollo 11, this PCR will not affect LR updating of the state vector.

REMARKS: